

EXPLOSIVE DUSTS

ADVANCED IMPROVISED
EXPLOSIVES

SEYMOUR LECKER

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Shock Sensitive Industrial Materials: Advanced Improvised Explosives

Explosive Dusts:
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by Seymour Lecker
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WARNING

The dusts and fine powders of all materials described in this manual are deadly explosives. Many of these materials are also extreme fire and explosive hazards in their natural forms, and some are deadly poisons. Whenever dealing with high explosives or hazardous materials, special precautions should be followed in accordance with industry standards for experimentation and production. Failure to strictly follow such industry standards may result in harm to life or limb.

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»Between 1910 and 1960, over two hundred fatalities were recorded as a result of explosions of agricultural dusts. In the same period, over one hundred additional fatalities were attributed to dust explosions in the plastics industry.«

National Fire Prevention Association

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PREFACE

Dust explosions account for a significant percentage of the industrial fire deaths that occur every year in mines, grain elevators, food processing plants, chemical plants, and other types of facilities. It is difficult for the ordinary person to comprehend the degree of explosive power of dust deposits. They can be detonated or ignited by heat, spark, flame, static electricity, or other means.

Each dust has a different optimal particle size for maximum explosibility, but generally the finer the particles the higher the explosive capability. Experiments by the United States Department of the Interior Bureau of Mines have shown that dusts composed of irregularly shaped particles represent a greater explosion hazard than those composed of spherical particles.

Dusts represent the most severe danger when the air in an enclosed space is saturated, but dusts can also be detonated when loosely packed in a nonconfining container.

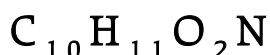
The extent of the hazard of any given dust is related to its ease of ignition and the severity of the ensuing explosion. All the dusts described in this manual are deemed to be severe explosive hazards by the Bureau of Mines.

All dusts should be considered potentially hazardous and toxic.

CHAPTER 1

INDUSTRIAL CHEMICALS

ACETO ACETANILIDE

**Synonyms**

Alpha-Ketobutyranilide, Alpha-Acetyl Acetanalide, N-Phenyl-acetamide.

Description

White, odorless crystalline powder or solid. Slightly burning taste.

Uses

Manufacture of penicillin and other Pharmaceuticals, dyestuffs, cellulose ester coatings, rubber, synthetic camphor.

Hazards

Highly toxic. Can release highly toxic fumes upon heating.

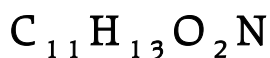
Fire Fighting

Alcohol foam, water mist, CO₂, dry chemical.

Additional Information

Can react vigorously with oxidizing materials.

ACETOCET-O-TOLUIDIDE

**Synonyms**

None.

Description

Fine white granular powder.

Uses

Manufacture of Hansa and benzidine yellows.

Hazards

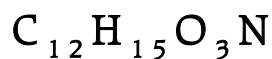
Moderately toxic. Avoid inhalation.

Fire Fighting

Water, foam, CO₂, dry chemical.

Additional Information

Combustible.

ACETOACET-P-PHENETIDIDE**Synonyms**

None.

Description

Crystalline powder.

Uses

Intermediate for azo pigments.

Hazards

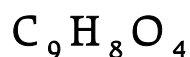
Moderately toxic. Avoid inhalation.

Fire Fighting

Water, foam, CO₂, dry chemical.

Additional Information

Combustible. Can react with oxidizing materials.

ACETYLSALICYLIC ACID**Synonyms**

Aspirin, Acetol, O-Acetoxybenzoic Acid.

Description

White crystals or powder. Slightly bitter taste.

Uses

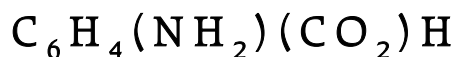
Medicine, most commonly aspirin tablets.

Hazards

A 10-gram dose can be fatal to an adult. Avoid inhalation of dust.

Fire Fighting

Water.

ANTHRANILIC ACID**Synonym**

O-Amino Benzoic Acid.

Description

Yellow, needle-like crystals. Sweetish taste.

Uses

Manufacture of dyes, drugs, perfumes, and Pharmaceuticals.

Hazards

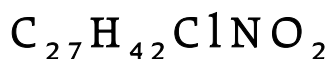
Moderately toxic. Avoid inhalation.

Fire Fighting

Water, alcohol foam.

Additional Information

Combustible.

BENZETHONIUM CHLORIDE**Synonym**

Hyamine 1622.

Description

Colorless, odorless crystals. Very bitter taste.

Uses

Antiseptic, cationic detergent.

Hazards

Highly toxic. Heat or contact with acid or acid fumes can lead to the release of toxic gas.

Fire Fighting

Water, dry chemical, CO₂ foam.

BENZOIC ACID

C_6H_5COOH

Synonyms

Carboxybenzene, Benzenecarboxylic Acid, Phenylformic Acid.

Description

White powder or white needle crystals.

Uses

Plasticizers, alkyd resins, food preservative, seasoning tobacco, flavors, perfumes, antifungal agent.

Hazards

Mildly toxic. Use in foods is restricted to 0.1%. Avoid skin contact or ingestion.

Fire Fighting

Water, CO_2 , dry chemical.

Additional Information

Combustible, Can react with oxidizing materials.

1,2,3-BENZOTRIAZOLE

$C_6H_4NHN_2$

Synonyms

Aziminobenzene, Benzene Azimide,

Description

White to light tan, odorless, crystalline powder or needlelike crystals.

Uses

Photographic restrainer, chemical intermediate.

Hazards

Highly toxic. Can release highly toxic fumes when heated.

Fire Fighting

Water, dry chemical.

Additional Information

Can detonate under vacuum distillation.

CARBARYL
C₁₀H₇OOCNHCH₃

Synonyms

Sevin, 1-Naphthyl Methyl Carbamate, 1-Naphthyl-N-Methylcarbamate.

Description

White crystals.

Uses

Insecticide.

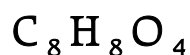
Hazards

Highly toxic. Avoid inhalation, ingestion, or skin contact.

Fire Fighting

Water.

DEHYDROACETIC ACID



Synonyms

3-Acetyl-6-Methyl-1, 2-Pyran-2, 24(3H)-Dione Methylacetopyranone, DHA.

Description

Colorless, odorless, tasteless crystals.

Uses

Fungicide, bactericide, medicated toothpastes, plasticizer, chemical intermediate.

Hazards

Highly toxic. Permitted as a food additive, but avoid ingestion.

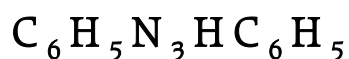
Fire Fighting

Water, foam.

Additional Information

Mildly combustible.

DIAZOAMINOBENZENE



Synonyms

(Alpha) Diazoamidobenzol; 1, 3 Diphenyl-triazine; Benzeneazo-anilide.

Description

Golden-yellow crystals.

Uses

Insecticide, organic synthesis, dyes.

Hazards

Highly toxic. Can release toxic fumes when heated,

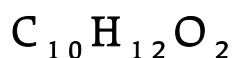
Fire Fighting

Dry chemical foam, CO₂

Additional Information

Can detonate if heated or shocked.

DICYCLOPENTADIENE DIOXIDE



Synonyms

None.

Description

White crystalline powder,

Uses

Intermediate for epoxy resins, plasticizers, and protective coatings.

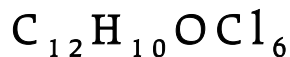
Hazards

Mildly toxic. Avoid inhalation.

Fire Fighting

Alcohol foam, dry chemical.

DIELDRIN



Synonyms

Compound 497, Octalox, HEOD.

Description

White odorless crystals.

Uses

Insecticide.

Hazards

Extremely toxic. Can release extremely toxic fumes when heated.

Fire Fighting

Water, dry chemical, foam CO₂.

DIMETHYL TEREPHTHALATE**Synonyms**

DMT, Dimethyl-1, 4-Benzene-Dicarboxylate.

Description

Colorless crystals.

Uses

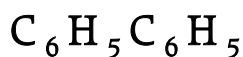
Polyester resins for film and fiber production.

Hazards

Moderately toxic. Avoid inhalation.

Fire Fighting

Alcohol foam.

DIPHENYL**Synonym**

Biphenyl.

Description

White scales. Pleasant odor.

Uses

Organic synthesis, heat transfer agent, fungistat in packaging of citrus fruit, plant disease control, dyeing assistant for polyesters.

Hazards

Highly toxic. Avoid inhalation or ingestion.

Fire Fighting

Water, CO₂, dry chemical.

Additional Information

Combustible. Can react with oxidizing materials.

FERRIC DIMETHYL DITHIOCARBAMATE
 $[(CH_3)_2NCSS]_3Fe$ **Synonyms**

Ferbam, Fennate.

Description

Dark to black fluffy powder. May be compressed to solid.

Uses

Fungicide.

Hazards

Moderately toxic. Can release highly toxic fumes when heated.

Fire Fighting

Water, dry chemical.

HEXAMETHYLENETETRAMINE
 $(CH_2)_6N_4$ **Synonyms**

Methenamine, HMTA, Aminoform, Hexamine Formamine, Urotropin, Metramine. Often erroneously called Hexamethylenamine.

Description

Colorless, lustrous crystals or white crystalline powder.

Uses

Curing of phenolformaldehyde; adhering rubber to textile; protein modifier; organic synthesis; manufacture of pharmaceuticals, fuel tablets, and shrinkproof textiles; fungicide; antibacterial; corrosion inhibitor.

Hazards

A skin irritant. Can release toxic fumes when heated.

Fire Fighting

Water, foam.

Additional Information

Combustible. Can react with oxidizing materials. Reacts violently with Na_2O_2 .

METHIONINE**Synonyms**

Methionine, 2-Amino-4-(methylthio)butyric acid.

Description

White crystalline powder.

Uses

Feed additive, vegetable oil enrichment, manufacture of pharmaceuticals. A nutrient.

Hazards

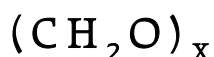
Unknown. Permitted as a food additive for humans.

Fire Fighting

Water, alcohol foam.

Additional Information

May react violently with powerful oxidizers or acids.

PARAFORMALDEHYDE**Synonym**

Paraform.

Description

White crystals, flakes, or powder. Odor of formaldehyde.

Uses

Fungicides, bactericides, disinfectants, adhesives, contraceptive creams, hardener, waterproofing agent for gelatin.

Hazards

Moderately toxic. Releases oxides of carbon and formaldehyde gas

when heated.

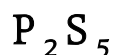
Fire Fighting

Alcohol foam, CO₂, dry chemical.

Additional Information

Can react with oxidizing materials. Reacts violently with O₂ liquid.

PHOSPHORUS PENTASULFIDE



Synonym

Phosphoric Sulfide, Phosphorus Persulfide, Thiophosphoric Anhydride.

Description

Light yellow or greenish yellow crystalline mass. Odor similar to hydrogen sulfide.

Uses

Insecticides, float agents, safety matches and other ignition compounds, intermediate for lubrication oil additives.

Hazards

Highly toxic. Can release highly toxic fumes when heated. Will react with water, steam, or acids to produce toxic and flammable vapors.

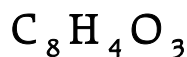
Fire Fighting

CO₂, snow, dry chemical, sand.

Additional Information

Can react vigorously with oxidizing materials. Combustible; ignites by friction.

PHTHALIC ANHYDRIDE



Synonym

Phthalandione.

Description

White crystalline needles. Mild odor.

Uses

Manufacture of resins, plasticizers, dyes, chlorinated products,

pharmaceuticals, and insecticides,

Hazards

Moderately toxic. A common air contaminant. Avoid inhalation.

Fire Fighting

CO₂, dry chemical,

Additional Information

Combustible. Can react with oxidizing materials. Explodes on contact with HNO₃.

PHTHALIMIDE



Synonym

1, 3-Isoindoledione.

Description

Light tan to white powder.

Uses

Fungicide, organic synthesis, laboratory reagent, manufacture of synthetic indigo.

Hazards

Can release toxic fumes when heated. Other toxic properties are unknown.

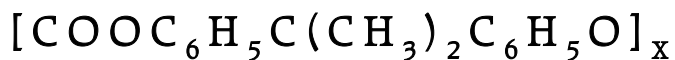
Fire Fighting

Water, dry chemical.

Additional Information

Combustible.

POLYCARBONATE



Synonyms

None.

Description

Transparent solid.

Uses

Heavily used in the manufacture of molded plastic products,

particularly those where strength of construction is of high importance.

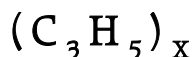
Hazards

Mildly toxic. Avoid inhalation or ingestion.

Fire Fighting

Self-extinguishing.

POLTPROPYLENE



Synonyms

None.

Description

Translucent, white to yellow solid.

Uses

Manufacture of molded plastic products, packaging film, acid-dyed clothing, artificial turf, surgical casts, synthetic paper, nonwoven disposable filters, and strapping.

Hazards

Mildly toxic. Permitted additive in food for human consumption.

Fire Fighting

Water, dry chemical.

Additional Information

Combustible, but slow burning. Reacts violently with strong oxidizing agents.

POLYSTYRENE



Synonyms

Polystyrol, Styrene Polymer, Styron, Styrofoam.

Description

Transparent to light yellow solid.

Uses

Manufacture of molded plastic products. As a foam it is a commonly used insulation.

Hazards

Mildly toxic. Avoid inhalation or ingestion.

Fire Fighting

Water, dry chemical.

Additional Information

Combustible.

**Synonyms**

Anasadol, Salinidol.

Description

White or slightly pink, odorless crystals.

Uses

Fungicide, slimicide, antimildew agent.

Hazards

Moderately toxic. Will irritate skin. Can release toxic fumes when heated.

Fire Fighting

Alcohol foam, CO₂, dry chemical.

**Synonyms**

2,4-Hexadienoic acid.

Description

Colorless needles.

Uses

Fungicide, mold inhibitor in food products, alkyd resin coatings, cold rubber additive, intermediate for plasticizers and lubricants.

Hazards

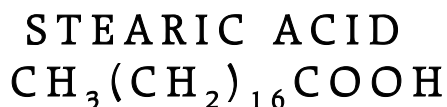
Mildly toxic. Avoid inhalation or ingestion.

Fire Fighting

Water.

Additional Information

Can react with oxidizing materials.



Synonyms

Octadecanoic Acid, N-Octadecanoic acid.

Description

White amorphous solid. Slight odor and taste of tallow.

Uses

Manufacture of lubricants, soaps, pharmaceuticals, cosmetics, shoe polish, metal polish, and ointments; dispersing agent and softener in rubber compounds.

Hazards

Highly toxic. Avoid inhalation, ingestion, or skin contact.

Fire Fighting

CO₂, dry chemical.



Synonyms

P-Phthalic Acid, TPA, Benzene-p-dicarboxylic acid.

Description

White crystals or powder.

Uses

Additive in poultry feeds; reagent for alkali in wool; production of linear, crystalline polyester resins, fibers, and films by combination with glycols.

Hazards

Moderately toxic. Avoid inhalation or ingestion.

Fire Fighting

CO₂, dry chemical.

Additional Information

Combustible. This was the twenty-first-highest chemical produced

by volume in the United States in 1985.

CHAPTER 2

METALS

ALUMINUM

Al

Synonyms

None.

Description

Silvery white crystalline solid.

Uses

Building and construction, corrosion-resistant equipment, die-cast auto parts, power transmission lines, paints, protective coating, packaging foil.

Hazards

Nontoxic. Avoid inhalation of powder.

Fire Fighting

Specially prepared dry powder.

Additional Information

Will react violently with powerful oxidizers. The most abundant metal in the Earth's crust.

IRON

Fe

Synonym

Ferrum.

Description

Silver white lustrous metal.

Uses

Manufacture of steel. Iron powder is used in manufacture of magnets, high-frequency cores, and auto parts. Used as a catalyst in ammonia synthesis.

Hazards

Dust is highly toxic. Iron oxide fumes are also highly toxic.

Fire Fighting

Special mixtures of dry chemicals.

Additional Information

Can react vigorously with oxidizing materials.

MAGNESIUM**Mg****Synonyms**

None.

Description

Silver white crystals of metal.

Uses

Flash photography, antiknock gasoline additives, optical mirrors, die-cast auto parts, dry and wet batteries, reducing agent; production of iron, nickel, zinc, titanium, zirconium, and steel.

Hazards

Moderately toxic. Avoid inhalation. Will release toxic fumes when heated.

Fire Fighting

Powdered talc, powdered graphite, sand.

Additional Information

Combustible. Will react violently with oxidizing materials, moisture, or metals. *Dusts from aluminum-magnesium alloys are extremely explosive.*

THORIUM**Th****Synonyms**

None.

Description

Silver white soft metal or powder.

Uses

Sun lamps, photoelectric cells, target in X-ray tubes, *nuclear fuel*.

Hazards

Radioactive.

Fire Fighting

Dry chemical, powdered talc, graphite.

Additional Information

Dust can ignite at room temperature. Can react with oxidizing materials.

TITANIUM

Ti

Synonyms

None.

Description

Dark gray powder or white lustrous metal.

Uses

X-ray tube target, electrodes in chlorine batteries, manufacture of alloys for a variety of special applications,

Hazards

Nontoxic. Dust is considered to be in the nuisance category.

Fire Fighting

Powdered talc or sand.

Additional Information

Combustible. Can react violently with a wide variety of chemicals. *Dusts from titanium-iron alloys (ferrotitanium) are extremely explosive.*

TITANIUM HYDRIDE

TiH₂

Synonyms

None.

Description

Dark gray or black metallic powder or crystals.

Uses

Production of pure hydrogen and foamed-metals solder for metal-glass composites, reducing atmosphere for furnaces.

Hazards

Moderately toxic. Avoid inhalation.

Fire Fighting

Dry chemical, powdered talc, sand.

Additional Information

Combustible. May react violently with oxidizing materials.

ZIRCONIUM

Zr

Synonyms

None.

Description

Grayish white lustrous metal.

Uses

Corrosion-resistant alloys, flashbulbs, special welding fluxes, getter in vacuum tubes, lab crucibles, manufacture of steel.

Hazards

Moderately toxic. Avoid inhalation of powder.

Fire Fighting

Dry powder, salt, sand.

Additional Information

Combustible. Can react with oxidizing materials. Dusts must be kept dry or completely soaked.

ZIRCONIUM HYDRIDE

ZrH₂

Synonyms

None.

Description

Gray black metallic powder.

Uses

Getter in vacuum-tube, source of hydrogen, metal foaming agent, reducing agent, nuclear moderator.

H a z a r d s

Moderately toxic. Avoid inhalation.

F i r e F i g h t i n g

Dry chemical, powdered talc, sand.

A d d i t i o n a l I n f o r m a t i o n

Combustible, especially when wet. Can react with oxidizing materials.

CHAPTER 3

CARBONACEOUS MATERIALS

ASPHALT

Synonyms

Bitumen, Petroleum Pitch.

Description

Black or dark brown mass.

Uses

Hot-melt adhesives, sealants, roof and road coatings.

Hazards

Moderately toxic. Can irritate skin.

Fire Fighting

Foam, CO₂, dry chemical.

Additional Information

Can react with fluorine.

COAL

Synonym

Anthracite.

Description

Black powder or chunks.

Uses

Heat, energy, production of synthetic crude oil and fuel gas.

Hazards

Moderately toxic. Avoid inhalation or ingestion.

Fire Fighting

Foam, CO₂, dry chemical.

Additional Information

Can react with oxidizing material.

GILSONITE

Synonym

Uintaite.

Description

Solid black asphaltic material.

Uses

Wire insulation compounds, black varnish, lacquers, baking enamels, linoleum and floor tile, paving, insulation, diluent in low-grade rubber compounds; add, alkali, and waterproof coatings.

Hazards

Moderately toxic. Can release toxic fumes upon heating.

Fire Fighting

Water foam, dry chemical, CO₂.

LIGNITE

Synonym

Brown Coal.

Description

Brown peat-like material. May contain 40-percent water before drying.

Uses

Fuel, production of polymer resins. May be used in the future to produce methanol.

Hazards

A nuisance dust. Avoid inhalation.

Fire Fighting

Water.

Additional Information

Can react with oxidizing materials.

CHAPTER 4

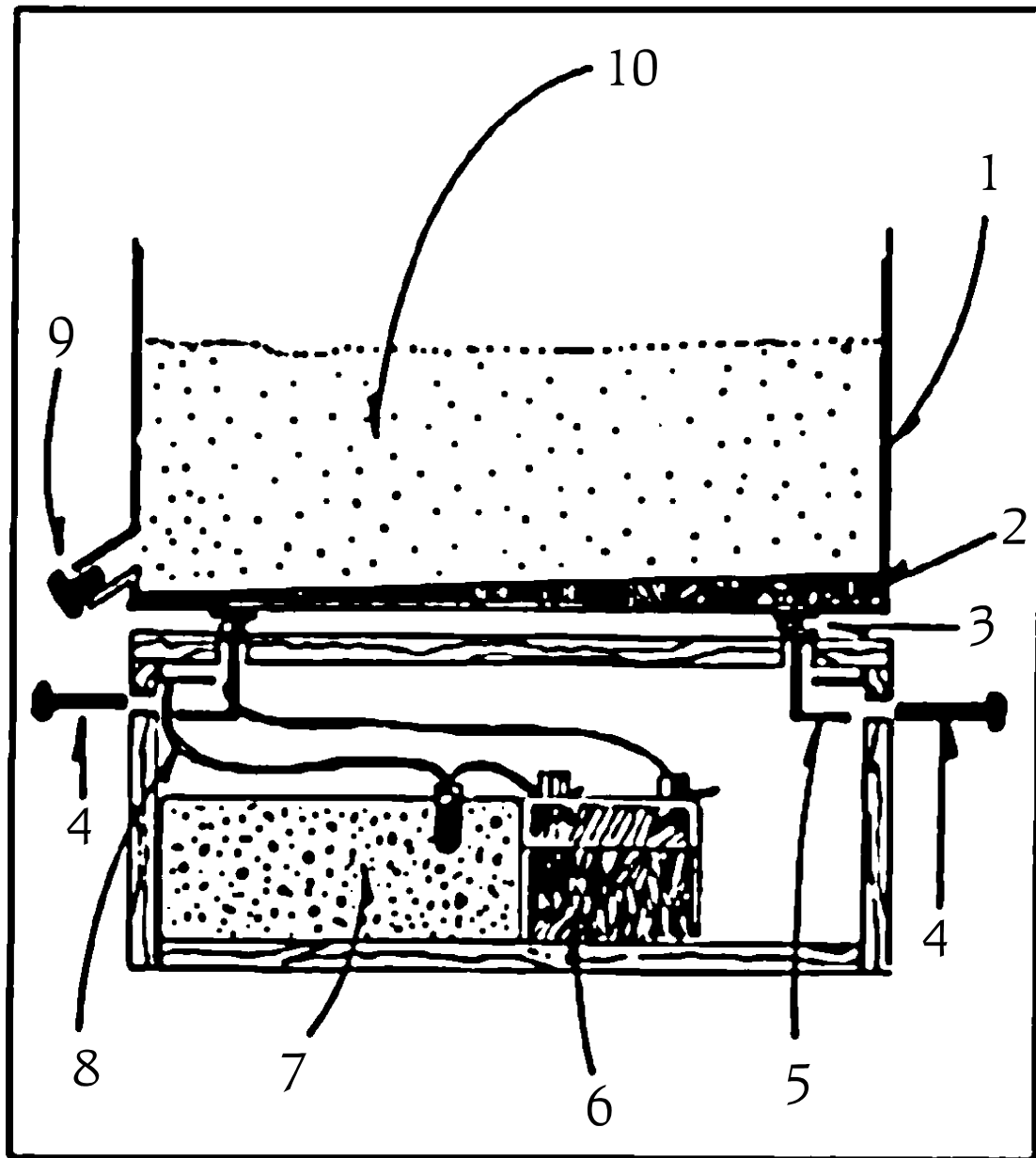
AGRICULTURAL PRODUCTS

Dusts of these agricultural products represent severe explosive dangers.

- ▶ Apricot pit
- ▶ Barley
- ▶ Brown sugar
- ▶ Cake flour (25-percent commeal)
- ▶ Cherry pit
- ▶ Cinnamon
- ▶ Cocoa bean shell
- ▶ Coconut shell
- ▶ Corn
- ▶ Corncobs
- ▶ Cornstarch
- ▶ Dehydrated citrus peel
- ▶ Filbert shell
- ▶ Hemp
- ▶ Oats
- ▶ Pea flour
- ▶ Peach pit shell
- ▶ Peanut hull
- ▶ Pecan shell
- ▶ Pectin
- ▶ Potato starch
- ▶ Rice
- ▶ Safflower
- ▶ Skimmed milk
- ▶ Soy
- ▶ Sugar
- ▶ Walnut shell
- ▶ Wheat
- ▶ Wheat starch
- ▶ Yeast

CHAPTER 5

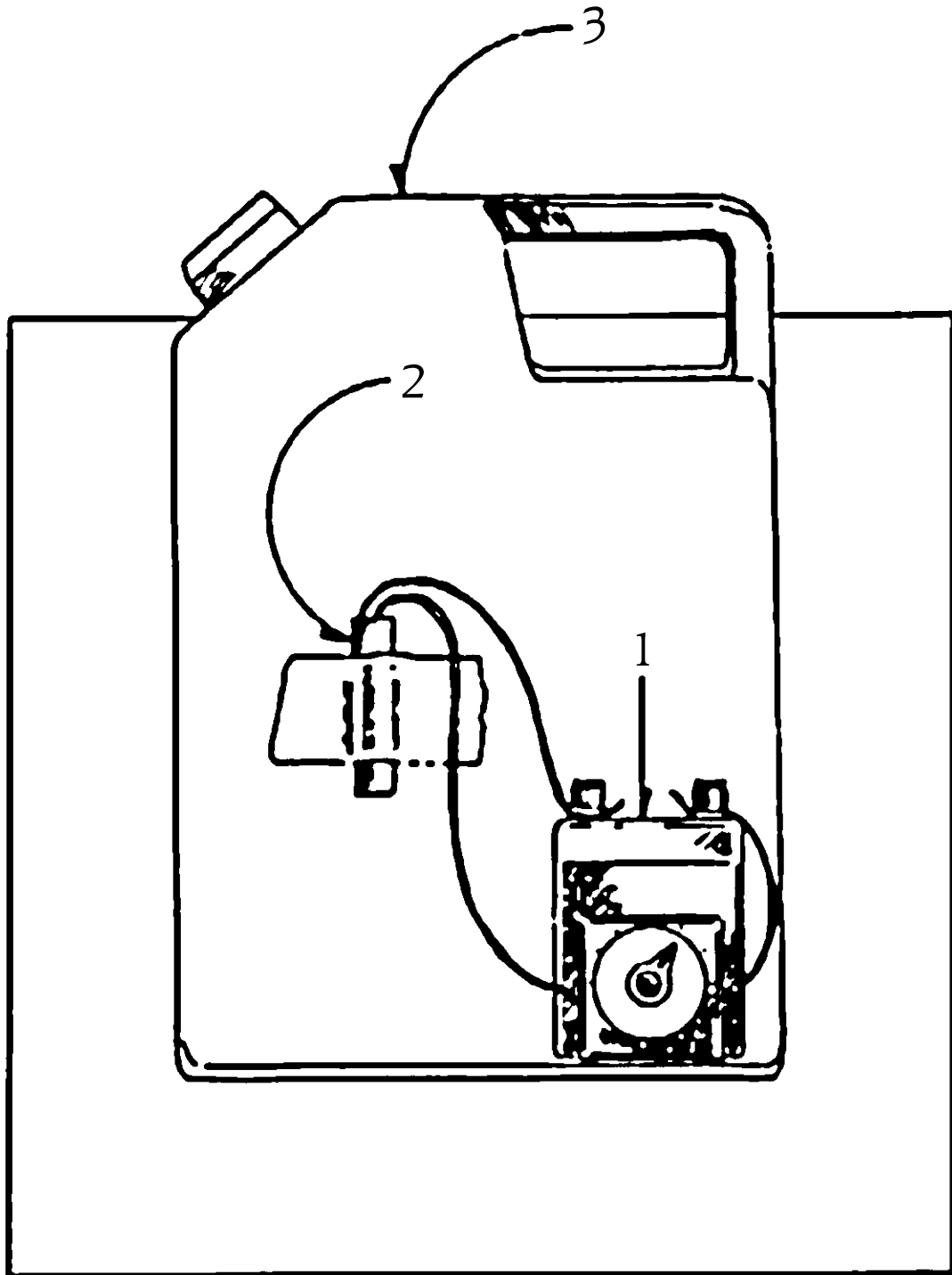
DEVICES



- 1. Container
- 2. Wedge (aids duet flow)
- 3. Spring

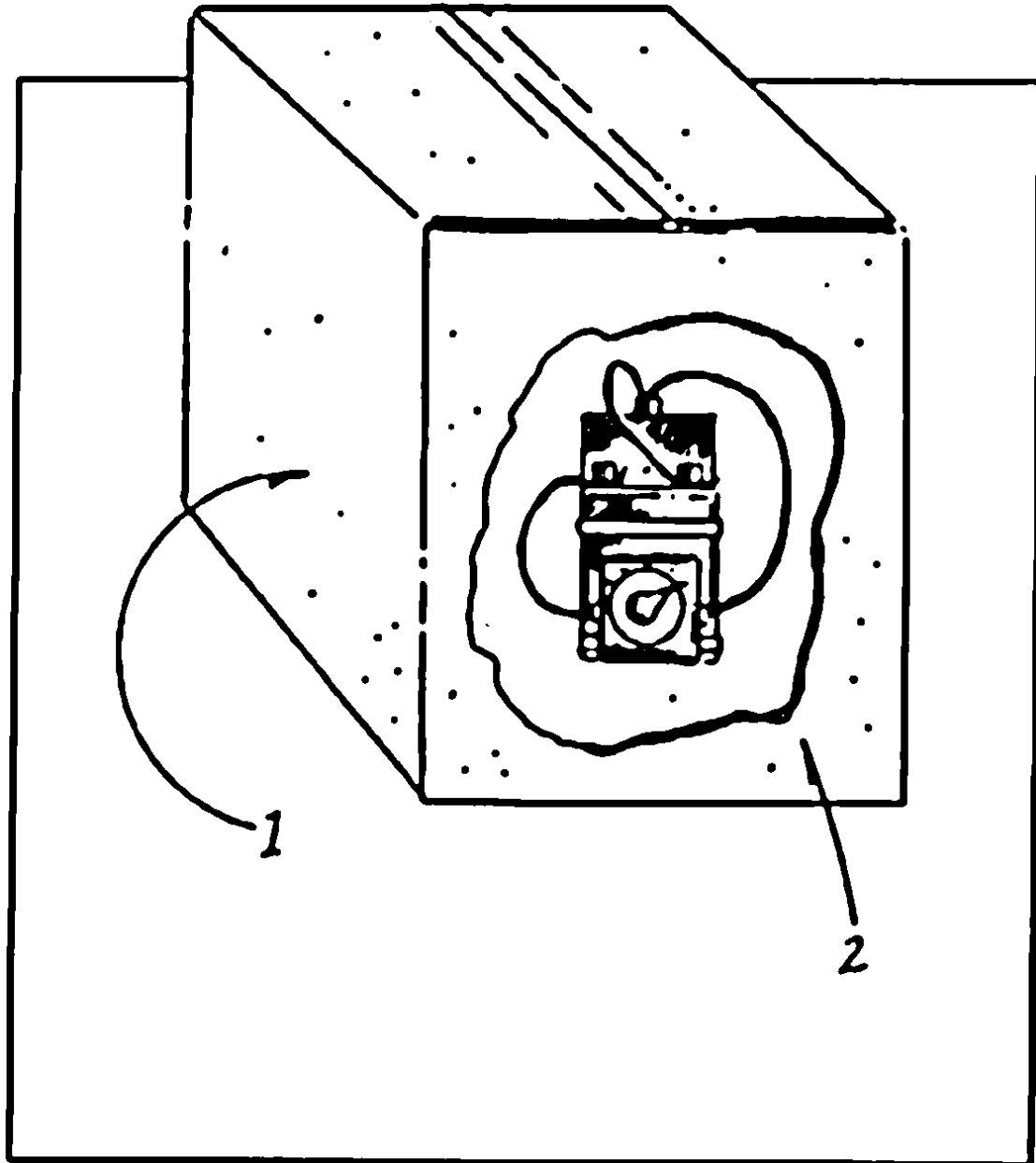
4. Safety plug
5. Optional second firing system
6. Battery
7. $\frac{1}{4}$ lb. explosive charge
8. Pressure-release firing system
9. Spout and plug
- 10.5 lbs. of dust (minimum)

Fill the container with a minimum of five pounds of dust. *Do not tamp the dust.* The weight of the dust keeps the pressure-release firing system in the open position. Place the device in the center of a closed room in an elevated position. Remove the plug from the container. Dust will flow from the container and form an extremely explosive mixture with the air. As the dust flows from the container, the pressure on the springs will weaken and the pressure-release firing system will detonate the charge.



1. Electrical firing system
2. $\frac{1}{4}$ lb. of explosive charge
3. Plastic jerry can containing 5 lbs. (minimum) of dust

Pour the dust into the jerry can at the last possible minute. Dust should not be allowed to settle and compress itself. Set timer to detonate at the appropriate time. Allow enough time to leave the vicinity but not enough time for the dust to settle in the jerry can.



1. Cardboard carton containing 5 lbs. (minimum) of dust
2. Electrical firing system with $\frac{1}{4}$ lb. explosive charge

Electrical firing system and charge should be wrapped in plastic and placed in the center of the carton. Set timer to detonate at the appropriate time. Allow enough time to leave the vicinity but not

enough time for the dust to settle in the box.

APPENDIX

RECOMMENDED READING

Improvised Munitions Black Book, Volume I
Frankford Arsenal (available from Paladin Press)

Special Forces Demolition Techniques
Paladin Press

Explosibility of Agricultural Dusts
U.S. Bureau of Mines
Report #5753

Explosibility of Metal Powders
U.S. Bureau of Mines
Report #6516

Explosibility of Carbonaceous Dusts
U.S. Bureau of Mines
Report #6597

Dust Explosibility of Chemicals, Drugs, Dyes, and Pesticides
U.S. Bureau of Mines
Report #7132

Explosibility of Miscellaneous Dusts
U.S. Bureau of Mines
Report #7208

Report of Important Dust Explosions (1957)
National Fire Protection Association

Theory and Nature of Dust Explosions
D.J. Price and H.H. Brown National Fire Protection Association